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(56) Literature Cited: Kokai 63-77404 (JP, A)
Kokai 54-33148 (JP, A)
Kokai 2-114908 (JP, A)
Jikkai 2-76918 (JP, U)

(54) [Title of the Invention] Electrically powered toothbrush

[Claims]

[Claim 1] An electrically powered toothbrush comprising:

a drive motor housed within a case;

a drive shaft supported within said case and displaceable in the axial direction;

a first motion conversion mechanism for converting rotation of said drive motor into reciprocating motion and transmitting same to said drive shaft;

an attachment coupled with said drive shaft;

a rotating brush head rotatably attached to the distal end of said attachment; and

a second motion conversion mechanism for converting reciprocating motion of said attachment in the axial direction into rotational motion and transmitting this [motion] to the brush head.

[Claim 2] The electrically powered toothbrush according to claim 1 further comprising an extension bar housed within said attachment, and that when said attachment is coupled with said drive shaft, couples with a fixed shaft fixed located within said case, so as to be capable of relative motion with respect to said attachment,

said extension bar comprising a rack meshing with a pinion provided on the rotating shaft of said brush head;

said pinion and said rack of said extension bar constituting said second motion conversion mechanism.

[Claim 3] The electrically powered toothbrush according to claim 2 wherein said fixed shaft concentrically passes through said drive shaft.

[Claim 4] The electrically powered toothbrush according to claim 3 wherein a cover for covering the top end portion of said drive shaft and said fixed shaft is provided within said attachment.

[0001]

[Detailed Description of the Invention]

[Field of Industrial Utilization] The invention relates to an electrically powered toothbrush.

[0002]

[Prior Art] A considerable number of electrically powered toothbrushes have been proposed to date, and electrically powered toothbrushes in a wide variety of configurations are currently available on the market. A typical product has an attachment with a brush head at its distal end, the attachment being detachable from and capable of relative motion with respect to the case, and driven in the longitudinal direction by a motor housed within the case; or has a brush head driven directly by the motor, rather than an attachment. Kokoku 61-55963, for example, discloses an electrically powered toothbrush whose bristle tips are designed to oscillate slightly. Kokai 61-64204 discloses an electrically powered toothbrush in which a toothbrush attached to the drive shaft undergoes reciprocating motion in the axial direction or at a right angle to the axis.

[0003] Also disclosed, in Kokai 61-79410, is an electrically powered toothbrush wherein the stroke of the reciprocating motion in the axial direction imparted to the toothbrush can be varied.

[0004]

[Problems the Invention Is Intended to Solve] The prior art designs described above [have a number of drawbacks]. In designs where slight oscillation is imparted to the brush head, this slight oscillation tends to be absorbed when the toothbrush chassis is gripped firmly, so that displacement occurring during brush head oscillation approaches zero, resulting in poor brushing action. In designs where motion is imparted to an attachment having a brush head (this usually corresponds to the shaft of the brush head), the brush head per se is fixed to the attachment and does not move. In designs where the brush head itself rotates, the attachment on which the brush head is mounted does not move. Accordingly, it is an object of the present invention to provide an electrically powered toothbrush endowed with excellent brushing action by means of imparting reciprocating motion in the axial direction to an attachment having a brush head, while at the same time imparting rotary motion to the brush head per se provided on the attachment; and to do so by means of a simple, inexpensive design.

[0005]

[Means for Solving the Problems] The invention provides [an electrically powered toothbrush] featuring a drive shaft supported within the case and displaceable in the axial direction, rotation of a motor housed within the case being converted by a first motion conversion mechanism to reciprocating motion which is transmitted to the drive shaft; and a rotating brush head rotatably attached to the distal end of an attachment that is coupled with the drive shaft, reciprocating motion of the attachment in the axial direction being converted by a second motion conversion mechanism into rotational motion which is transmitted to the brush head. In preferred practice, the attachment will house an extension bar that, when the attachment is coupled with the drive shaft, couples with a fixed shaft fixed located within the case, so as to be capable of relative motion with respect to the attachment, this extension bar comprising a rack that meshes with a pinion provided on the rotating shaft of the rotating brush head, and this pinion and rack constituting the second motion conversion mechanism. In preferred practice, the fixed shaft concentrically passes through the drive shaft.

[0006]

[Operation] Rotation of the motor housed within the case is converted by the first motion conversion mechanism and transmitted to the attachment via the drive shaft, whereby the attachment undergoes reciprocating motion; at the same time, the

reciprocating motion of the attachment per se is converted by the second motion conversion mechanism and transmitted to the rotating brush head located at the distal end of the attachment, to drive rotation of the rotary brush head.

[0007]

[Description of the Embodiments] The following description of a first embodiment of the invention makes reference to Figs 1 to 4. As depicted in Figs. 1 and 2, a hollow cylindrical case 1 having an opening 1a at its top end houses, via a support member 3, a DC motor 2 that has a dry cell (not shown) as its power supply. A bevel gear 4 is rotatably supported on the support member 3 via a shaft 5. The teeth of this bevel gear 4 mesh with a motor pinion 6 provided to the DC motor 2.

[0008] An eccentric cam 4a is integrally formed on a side face of the bevel gear 4, this eccentric cam 4a engaging a cam follower 7. As depicted in Fig. 1 the cam follower 7 has an aperture 7a of a height equal to the diameter of the eccentric cam 4a, the eccentric cam 4a mating with the aperture 7a. Rotation of the bevel gear 4 in a first direction about the shaft 5 is converted into vertical reciprocating motion by means of the cam follower 7, which follows the rotation of the eccentric cam 4a. The eccentric cam 4a and cam follower 7 constitute a first motion conversion mechanism for converting rotation of the DC motor 2 into reciprocating motion. In the upper central portion of the support member 3 is supported a hollow drive shaft 8 slidable in the axial direction thereof (the vertical direction in Fig. 1). The bottom end of the drive shaft 8 is linked to an arm 7b on the top of the cam follower 7 so that vertical reciprocating motion of the cam follower 7 is transmitted to the drive shaft 8. A fixed shaft 9 passes concentrically through the center bore of the drive shaft 8, the bottom end of the fixed shaft 9 being bent into "L" shape so as to project from a notched portion made in the drive shaft 8; this distal end 9a is fixed to the inside wall of the support member 3. Water entering the case 1 through the top opening 1a is prevented by the support member 3 from penetrating into the interior of the case 1 where the DC motor 2 and bevel gear 4 etc. are located. An attachment 10 having an opening 10a at its bottom end is detachably attached, via a coupling adapter 16 (described later) to the distal end of the drive shaft 8. Accordingly the attachment 10, moving in tandem with the drive shaft 8, undergoes reciprocating motion in the vertical direction with respect to the case 1. A shaft 12 is provided within the attachment 10 at its distal end. A rotary brush head 11 having a plurality of bristles is rotatably and detachably provided to the attachment 10 via this shaft 12. This shaft 12, which is the center of rotation for the rotary brush head 11, has pivoted thereon a pinion 13 that rotates in tandem with the rotary brush head 11. A plurality of lands 10b are formed in the interior of the attachment 10. An extension bar 15 is supported by these

lands 10b so as to slide in axial direction thereof (the vertical direction in Fig. 1) within the attachment 10. The distal end of the extension bar 15 is bent into "L" shape, with a rack 15a that meshes with the teeth of the pinion 13 being formed at this distal end. Water drain openings 10c for draining any water that may enter the space between the attachment 10 and the rotary brush head 11 are provided in the outside peripheral wall of the attachment 10. A coupling adapter 16 having a through-hole 16a in its center is secured to the bottom end of the attachment 10. As shown in Fig. 4, with the attachment 10 inserted into the top opening 1a of the case 1, the bottom end of the through-hole 16a of the coupling adapter 16 couples with the upper end of the drive shaft 8. Thus, in tandem with motion of the drive shaft 8 the attachment 10 undergoes vertical reciprocating motion with respect to the case 1. With the coupling adapter 16 coupled with the drive shaft 8 in this way the top end of the fixed shaft 9 passing through the drive shaft 8 projects up through the through-hole 16a of the coupling adapter 16 and into the interior of the attachment 10. A linking coupler 17 having an opening 17a at is bottom end is secured to the lower end of the extension bar 15. The opening 17a of the linking coupler 17 couples with the top end of the fixed shaft 9 when the coupling adapter 16 of the attachment 10 is mounted on the drive shaft 8. Thus, while the attachment 10, in tandem with motion of the drive shaft 8, undergoes vertical reciprocating motion with respect to the case 1, the extension bar 15, which is coupled to the fixed shaft 9, does not move with respect to the case 1. Thus, as depicted in Fig. 3, up-and-down motion of the attachment 10 is accompanied by reciprocating rotary motion of the pinion 13 about its shaft 12, due meshing [of the pinion] with the rack 15a of the extension bar 15. This rotary motion of the pinion 13 is transmitted directly to the rotary brush head 11 so that the rotary brush head 11 undergoes reciprocating rotary motion on the attachment 10. In this way, the pinion 13 and rack 15a constitute a second motion conversion mechanism for converting reciprocating up-and-down motion (longitudinal motion) of the attachment 10 into rotary motion. The description now turns to operation. Grasping the outside of the case 1 and turning a switch (not shown) to ON activates the DC motor 2. Rotation of the DC motor 2 is transmitted via the motor pinion 6 and bevel gear 4 and converted by the first motion conversion mechanism (i.e. eccentric cam 4a and cam follower 7) into reciprocating motion in the lengthwise direction of the case 1, which is transmitted to the drive shaft 8 so that the attachment 10 undergoes vertical reciprocating motion with respect to the case 1 , in tandem with motion of the drive shaft 8. As the attachment 10 undergoes vertical motion the pinion 13 --which meshes with the rack 15a at the top end of the extension bar 15 coupled with the fixed shaft 9 affixed to the case 1-- undergoes reciprocating rotary motion about the shaft 12 (see Fig. 3) so that the rotary brush head 11

undergoes reciprocating rotary motion at the distal end of the attachment 10. In this embodiment the first motion conversion mechanism for converting rotation of the DC motor 2 into reciprocating motion is composed of an eccentric cam 4a and cam follower 7, but is not limited thereto, other methods such as a linking mechanism or slider mechanism being possible as well. The second motion conversion mechanism for converting reciprocating motion of the attachment 10 in the vertical (axial) direction here consists of a pinion 13 and a rack 15a, but is not limited thereto, other methods such as a linking mechanism or slider mechanism being possible as well. A second embodiment of the invention is now described making reference to Fig. 5. In the first embodiment, as depicted in Fig. 4, it is conceivable that water entering the space between the attachment 10 and the rotary brush head 11 could penetrate between the drive shaft 8 and the fixed shaft 9 to reach the interior of the case 1. The case 1 houses the drive motor 2, dry cell (not shown) and other components, and in actual fact it is undesirable for these components to become wet. Accordingly, in the second embodiment illustrated in Fig. 5, a cover 21 for covering the upper end of the drive shaft 8 and the fixed shaft 9 is provided within the attachment 10. This cover 21 is of hollow cylindrical configuration having an opening 21a at its bottom end, and provided at its top end with a through-hole 21b through which the extension bar 15 may pass. A flanged portion 21c for mating with a mating projection 10d provided to the inside of the attachment 10 is formed on the outer wall at the bottom end of the cover 21. Additionally, the inside lip of the cover 21 mates with a projection 20b projecting up from the top face of the coupling adapter 20. The inside wall of the projection 20b of the coupling adapter 20 is coplanar with the opening 21a, the bottom end of the linking coupler 17 being inserted along this surface. As the outside diameter of the linking coupler 17 is equal to the diameter of the uppermost inside wall (inside diameter) of the bore of the cover 21, any water entering the space between the attachment 10 and the rotary brush head 11is prevented from penetrating into the cover 21 through the through-hole 21b. By covering the top end of the drive shaft 8 and fixed shaft 9 with a cover 21 in this way, any water entering into the attachment 10 is blocked by the cover 21 and thus prevented from penetrating between the drive shaft 8 and fixed shaft 9 and into the interior of the case 1.

[0009]

[Effects of the Invention] According to the electrically powered toothbrush set forth herein, reciprocating motion may be imparted to an attachment having a brush head while at the same time imparting rotary motion to the brush head per se provided on the attachment, thereby providing an electrically powered toothbrush endowed with excellent brushing action, by means of a simple, inexpensive design. By covering the top end of

the drive shaft and fixed shaft with a cover, any water entering the attachment can be prevented from penetrating between the drive shaft and fixed shaft, so that components housed within the case do not become wet.

[Brief Description of the Drawings]

[Fig. 1] A sectional front view illustrating a first embodiment.

[Fig. 2] A sectional view taken along line A-A in Fig. 1.

[Fig. 3] An enlarged fragmentary view depicting operation.

[Fig. 4] An enlarged sectional view.

[Fig. 5] An enlarged sectional view illustrating a second embodiment.

[Key]

1 case

2 drive motor

4a, 7 first motion conversion mechanism

8 drive shaft

9 fixed shaft

10 attachment

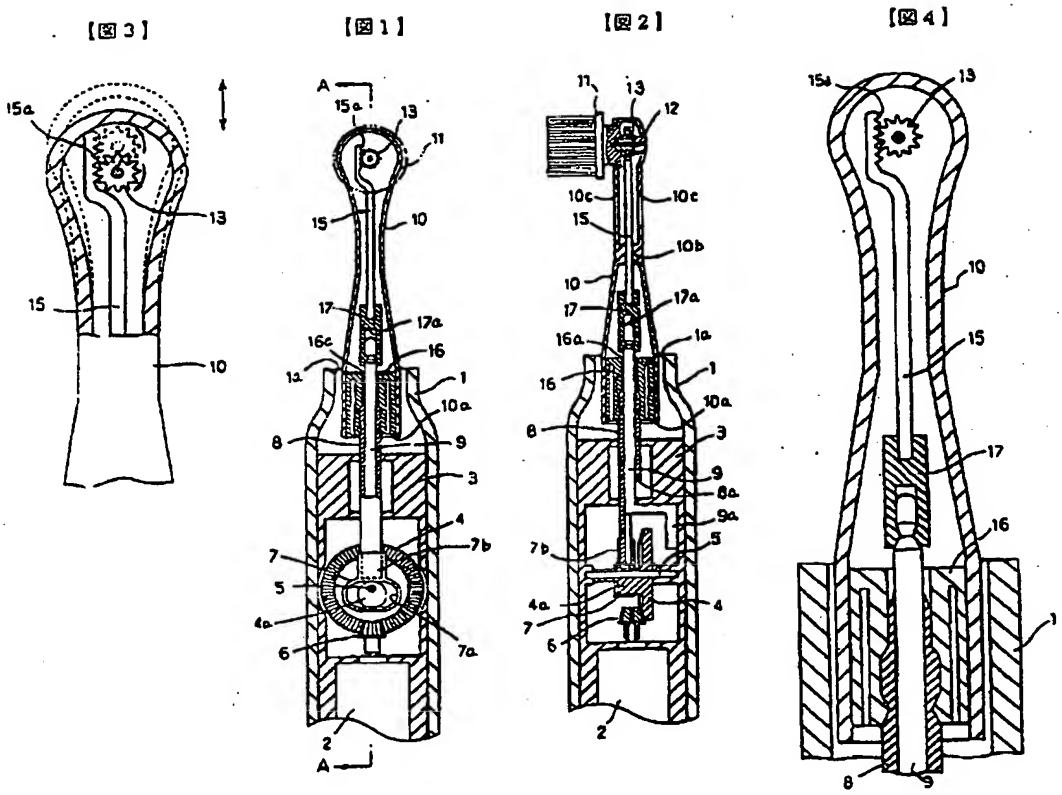
11 rotary brush head

13, 15a second motion conversion mechanism

15 extension bar

21 cover

[Fig. 3] [Fig. 1] [Fig. 2] [Fig. 4]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A
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10a
8
9
3
4
7b
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5
4a
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7a
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12
10c
10b
16a
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8a

[Fig. 5]

【図５】